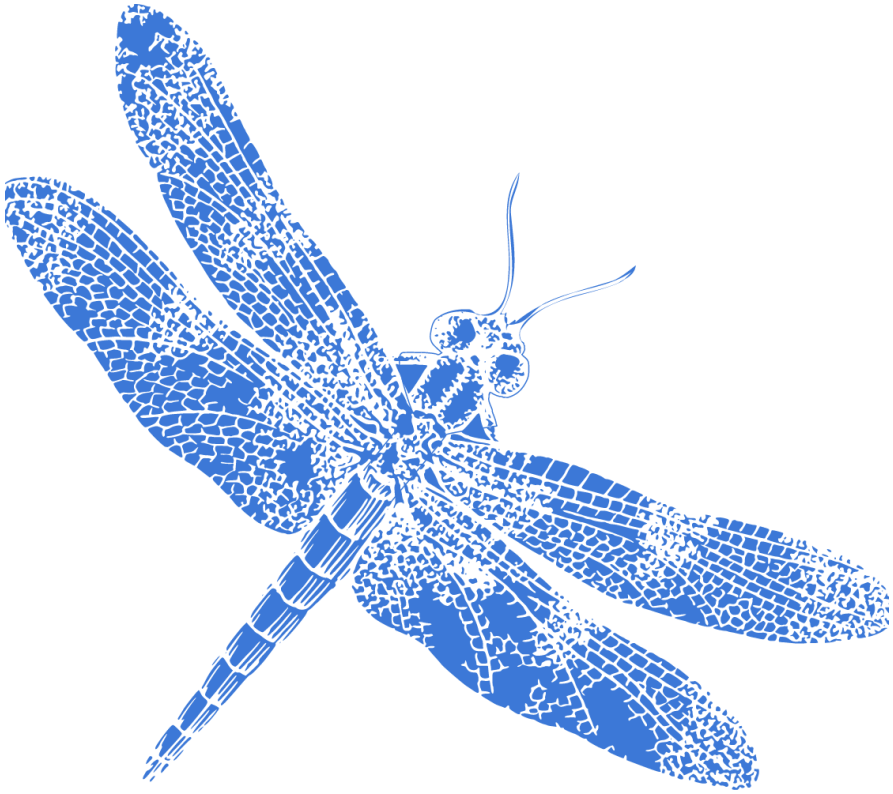

Earth and Space Systems:
Natural Resources, Earth Systems, Renewable and Non-Renewable Energy, Human Impacts

Washington University in St. Louis
Institute for School Partnership

Unit 22: Assessments Answer Key

Using Our Resources Wisely

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TABLE OF CONTENTS

Section 1 Pre/Post Assessment Answer Key 7 pts

Unit 22 | Section 1: What are natural resources and how are they used to produce energy?

Name: _____ Date: _____

Use the following story, along with the graphs provided, to answer questions 1-4.

Electricity Use

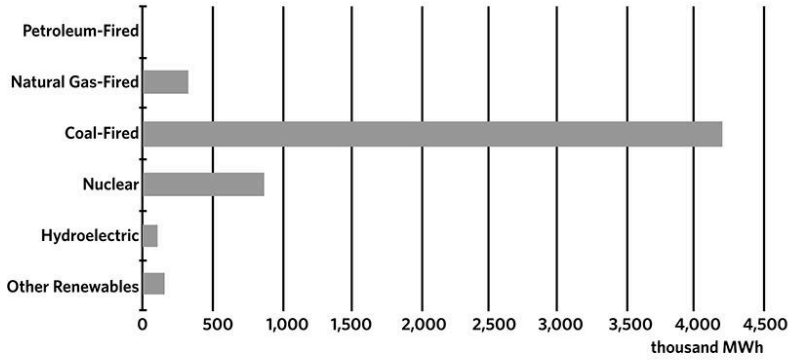
Electricity is used to power lights and appliances in our homes, schools, workplaces, and businesses. Different places around the world generate their electricity in different ways. The following bar graphs show how two different states generate electricity. Missouri is a state in the middle of America, while California is a west coast state on the Pacific Ocean.

1. Where do humans get energy from to use electricity to power lights in our home or school? 1 POINT
    a. The soil
    b. Plugs in the wall
    c. Human-made resources
    d. Natural resources

2. Which of the following is NOT an example of a renewable energy source? 1 POINT
    a. Sunlight is collected via solar panels to produce electricity.
    b. Coal is burned to generate electricity.
    c. Water hydropower is used in dams to generate electricity.
    d. Winds rotate turbines to make electricity.

3. The graph below shows the energy sources used to generate electricity in Missouri. Use the graph to answer Parts a and b.

Missouri Net Electricity Generation by Source, Mar. 2016



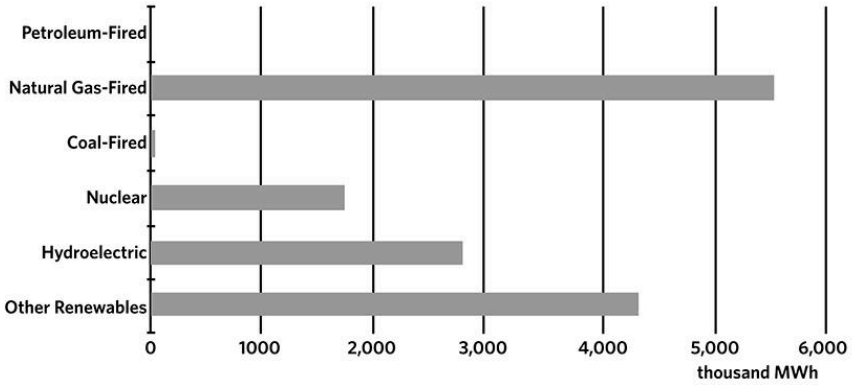
Source: Energy Information Administration, Electrical Power Monthly

a. Which source does Missouri use the most to generate electricity? 1 POINT

Missouri gets most of its electricity from coal.

This graph shows the energy sources used to generate electricity in California. Use this graph, along with the previous Missouri graph, to answer part b.

California Net Electricity Generation by Source, Mar. 2016



Source: Energy Information Administration, Electrical Power Monthly

b. Which state uses more renewable energy, California or Missouri? Use evidence from the graph in your answer. 2 POINTS

2 POINT ANSWER: California uses more renewable energy than Missouri. They use over 4,000 units of renewables, while Missouri only uses less than 500. *To earn two points, students should correctly identify California and provide numerical evidence from the graph.*

1 POINT ANSWER:
California uses more renewable energy than Missouri.

4. Wind can be used to generate electricity. Explain how humans use technology to transform wind energy into electricity. 2 POINTS

TWO POINT ANSWER:
Wind turbines are a type of technology that can be used to transform wind energy into electrical energy. Wind causes the turbine blades to turn. This causes another part of the turbine to turn. That part is connected to a generator, which makes electricity that is sent to places through power lines.

To earn two points, students should identify wind turbines as the technology source. They should then generally describe how wind turbines use blades to turn parts in the turbine that then generate electricity.

ONE POINT ANSWER:
Wind turbines are a technology that turns wind energy into electricity.

Unit 22 | Section 1 Assessment Standards Breakdown

STANDARDS ADDRESSED IN QUESTION 1: (Lesson 1)		
ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.		
STANDARDS ADDRESSED IN QUESTION 2: (Lesson 1)		
ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.		
STANDARDS ADDRESSED IN QUESTION 3: (Lesson 2)		
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.		
SCIENCE & ENGINEERING PRACTICES	**DISCIPLINARY CORE IDEAS**	**CROSSCUTTING CONCEPTS**
Obtaining, Evaluating, and Communicating Information • Obtain and combine information from reliable media to explain phenomena.	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	
STANDARDS ADDRESSED IN QUESTION 4: (Lesson 3)		
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses		

affect the environment.		
SCIENCE & ENGINEERING PRACTICES	**DISCIPLINARY CORE IDEAS**	**CROSSCUTTING CONCEPTS**
Obtaining, Evaluating, and Communicating Information ● Obtain and combine information from reliable media to explain phenomena.	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Cause and Effect ● Cause and effect relationships are routinely identified and used to explain change

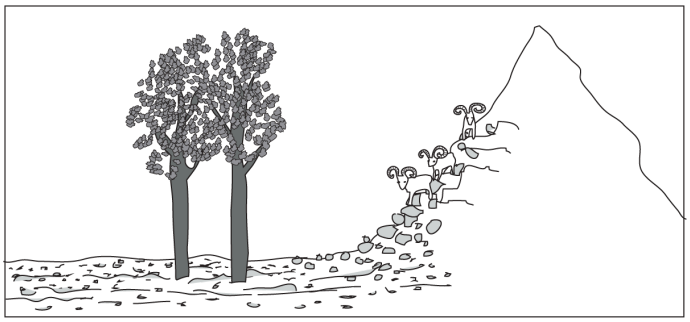
Section 2 Pre/Post Assessment Answer Key 6 pts

Unit 22 | Section 2: What are the Earth's systems?

Name: _____ Date: _____

Coastal Mountains

The Sierra Nevadas are a coastal mountain range of western North America in California, near the Pacific Ocean. They are an important source of power and water for the state. The highest peak is 14,000 feet above sea level. There are many streams running down the ocean-facing side of the mountains. The location of the mountains causes a large amount of precipitation from November to April on the ocean-facing side, while the other side of the mountain is very dry. Different parts of the mountain have different organisms. The lower mountain areas have giant sequoia trees and fir trees, while the colder, lower oxygen, higher parts of the mountain have moss and small flowering plants.



1. Animals that live on the mountain walk around on the large rocks. The rocks break up. This forms soil. Soil allows trees to grow on the bottom half of the mountain.
    a. Explain how two parts of one of Earth's spheres are interacting in this example. Name the sphere and describe how the two parts interact. 2 POINTS

TWO POINT ANSWER:
The trees and animals are two parts of the biosphere. The animals break rocks, causing the soil to be made. This allows trees to grow.
To earn two points, students should name the biosphere and describe how the plants rely on the animals to help create the soil.

ONE POINT ANSWER:
The trees and animals interact in the biosphere.

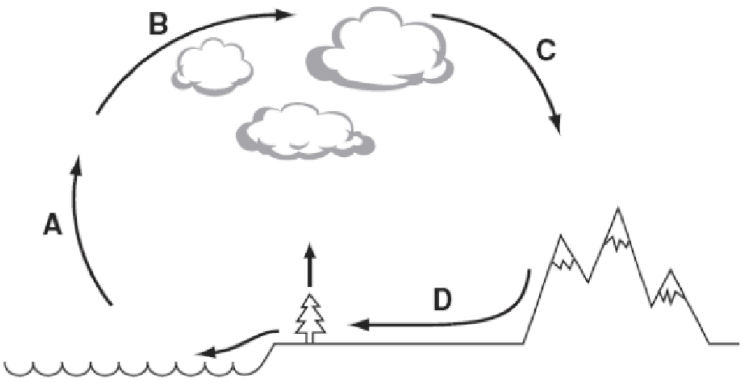
b. Explain how one Earth sphere is helping another Earth sphere function in this example. Be sure to name the spheres in your answer. 2 POINTS

TWO POINT ANSWER:
The geosphere is helping the biosphere function, because without the soil, the trees would not be able to grow.

To earn two points, students must name the two spheres and describe the interaction. Alternatively, students could write that the animal is helping the rock turn into soil.

ONE POINT ANSWER:
Option 1: The geosphere is interacting with the biosphere.
Option 2: The soil helps the trees grow.

Look at the model of the Sierra Nevadas below to answer Questions 2 and 3.



2. At point C in the model, predict what would happen to the water in the hydrosphere. 1 POINT
   a. The water will stay as a gas.
   b. The water will change from a solid to a liquid.
   c. The water will change from a gas to a solid or liquid.
   d. The water will stay as a solid.

If students choose B or D, they may have the misconception that clouds are solid.

3. What is the cause of water rising from the ocean to the atmosphere in point A of the model? 1 POINT
   a. The water is cooling due to ocean currents from the poles.
   b. The water is being heated up by energy from the sun.
   c. The water becomes lighter near the surface of the ocean and is able to float into the air.
   d. The water is pulled up because it is attracted to particles in the atmosphere.

Unit 22 | Section 2 Assessment Standards Breakdown

<table>
<tr><th colspan="3">STANDARDS ADDRESSED IN QUESTION 1: (Lesson 4)</th></tr>
<tr><td colspan="3">5-ESS2-1.(5.ESS2.A.1) Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact</td></tr>
<tr><th>SCIENCE & ENGINEERING PRACTICES</th><th>DISCIPLINARY CORE IDEAS</th><th>CROSSCUTTING CONCEPTS</th></tr>
<tr><td>Developing and Using Models
Use models to describe phenomena.</td><td>ESS2.A: Earth Materials and Systems
Earth’s major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth’s surface materials and processes.</td><td>Systems and System Models
A system can be described in terms of its components and their interactions.</td></tr>
<tr><th colspan="3">STANDARDS ADDRESSED IN QUESTION 2: (Lesson 5)</th></tr>
<tr><td colspan="3">3.PS1.A.1 Predict and investigate that water can change from a liquid to a solid (freeze), and back again (melt), or from a liquid to a gas (evaporation), and back again (condensation) as the result of temperature changes.</td></tr>
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</table>

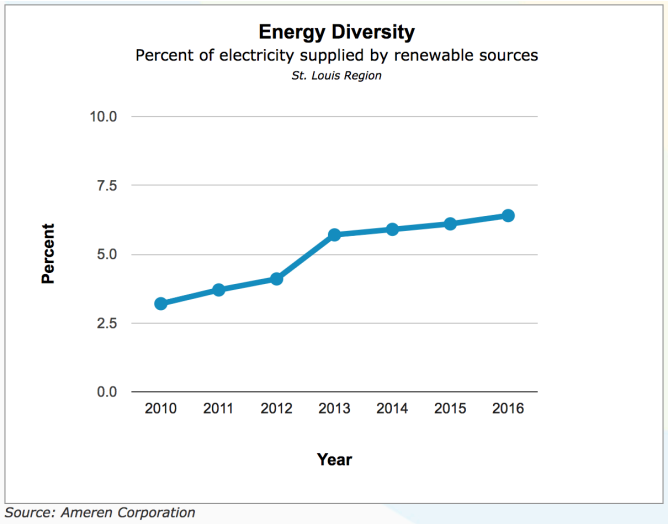
Section 3 Pre/Post Assessment Answer Key 9 pts

Unit 22 | Section 3: How do humans impact the Earth's systems?

Name: _____ Date: _____

Energy Use in St. Louis

St. Louis currently uses about 94% nonrenewable energy in the form of coal. In 2017, the City of St. Louis set a goal to use 100% renewable energy by the year 2035. Energy utility companies like Ameren Missouri have also announced that they are going to use more wind and solar power for electricity generation in the region.



Source: Ameren Corporation

1. Explain how the use of wind energy affects the environment compared to coal. 2 POINTS

2 POINT ANSWER:
Wind energy use causes less environmental damage than coal use. Coal use causes pollution/damage to habitats, while wind energy does not. Coal is also not renewable, so constantly has to be taken from the ground, while wind is renewable and freely available.

To earn two points, students should point out that wind energy causes less damage to the environment because coal causes pollution and damages habitats. They should describe that wind is renewable and easy to obtain.

ONE POINT ANSWER:
Option 1: Wind energy is better for the environment./Coal harms the environment.
Option 2: Wind energy is renewable, while coal is not.

2. Describe how changes to the atmosphere will affect the biosphere of St. Louis if the city meets its goal of 100% renewable energy in 2035.

TWO POINT ANSWER:
The atmosphere will be less polluted because there will be less pollution from the coal. Because the atmosphere will be less polluted, the organisms in the biosphere, including humans, will be healthier since they will have cleaner air.

In order to earn two points, students must say that the atmosphere will be less polluted with less coal emissions, and connect this to the health of organisms in the biosphere.

ONE POINT ANSWER:
The atmosphere will help the biosphere be healthier.

3. Circle the human activities that will have a negative impact on one or more Earth spheres.
5 POINTS, give 1 point for each of the statements identified correctly as negative or not.

	A stream team cleans the plastic water bottles out of a river.
Negative	Gasoline is burned as a school bus drives around.
Negative	Trees are removed from a forest to make way for a new farm.
	A family recycles all plastic, glass, aluminum, and paper.
	A factory develops a technology that creates less pollution from its building.

Unit 22 | Section 3 Assessment Standards Breakdown

STANDARDS ADDRESSED IN QUESTION 1: (Lesson 6, 7)		
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.		
SCIENCE & ENGINEERING PRACTICES	**DISCIPLINARY CORE IDEAS**	**CROSSCUTTING CONCEPTS**

Obtaining, Evaluating, and Communicating Information ● Obtain and combine information from reliable media to explain phenomena.	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	Cause and Effect ● Cause and effect relationships are routinely identified and used to explain change
STANDARDS ADDRESSED IN QUESTIONS 2 and 3: (Lesson 6, 7)		
5-ESS3-1. (5.ESS3.C.1) Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.		
SCIENCE & ENGINEERING PRACTICES	**DISCIPLINARY CORE IDEAS**	**CROSSCUTTING CONCEPTS**
	ESS2.A: Earth Materials and Systems ● Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. ESS3.C: Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Systems and System Models ● A system can be described in terms of its components and their interactions.

Section 4 Pre/Post Assessment Answer Key 7 pts

Unit 22 | Section 4: How much of the water on the planet is drinkable?

Name: _____ Date: _____

Earth's Water

Earth has different types of water. Some water is saltwater, which contains salt. Some water is freshwater, which does not contain salt. Humans use water as a resource for farming, bathing, eating, drinking, cleaning, going to the bathroom, and making goods.

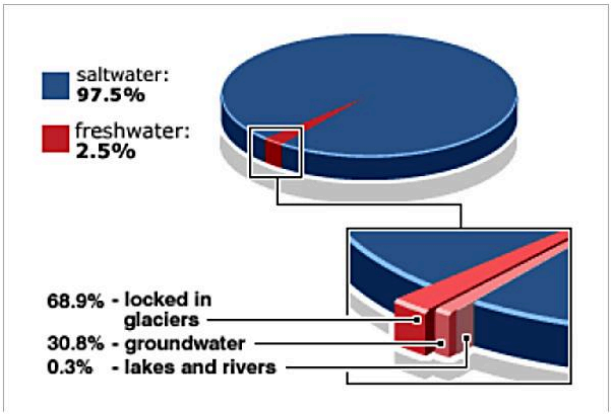
1. Where is most of Earth's water located? Use the graph below and your knowledge of science to answer the question. 1 POINT

   a. Glaciers

   b. Oceans

   c. Rivers and lakes

   d. Groundwater



2. Using your science knowledge, describe how it is possible that only about 0.4% of Earth's water is drinkable.

TWO POINT ANSWER:
Saltwater is not safe for humans to drink. We can't access most freshwater because it is frozen, so this leaves us with mostly water from rivers that we can drink.

In order to earn two points, students must say that saltwater is unsafe to drink, and describe that most freshwater is frozen and undrinkable.

ONE POINT ANSWER:
Option 1: Saltwater is not safe to drink.
Option 2: Most freshwater is frozen and we cannot get to it.

3. Identify one human activity and explain how it affects the quantity and quality of freshwater on Earth. 2 POINTS

TWO POINT ANSWER:
Example: Humans can limit the length of their showers. This will affect the quantity of freshwater by saving more for others.

To earn two points, students must identify a positive or negative human activity and share that it conserves water (positive) or decreases access to clean water (negative) such as: Positive - fixing a leaky toilet, limiting baths or Negative - farming with pesticides and fertilizers that contaminate. water, long showers, sewage.

ONE POINT ANSWER:
Example: Humans take long showers.

4. Using the graph from question 1 and your knowledge of science, explain why it is important to protect freshwater resources on Earth. 2 POINTS

TWO POINT ANSWER:
Most of the water on Earth is not freshwater (less than 3%) so it is important that we keep this water clean in order to continue to provide the water resources humans need (for drinking especially, since we cannot drink salt water).

To earn two points, students must point out evidence from the graph about the percentage of freshwater, and connect that to the need for conservation of water for drinking.

ONE POINT ANSWER:
Humans need to save drinking water because there is not a lot of it.

Unit 22 | Section 4 Assessment Standards Breakdown

STANDARDS ADDRESSED IN QUESTION 1: (Lesson 8)

5-ESS2-2. (5.ESS2.C.1) Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Using Mathematics and Computational Thinking ● Describe and graph quantities such as area and volume to address scientific questions.	ESS2.C: The Roles of Water in Earth's Surface Processes ● Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Scale, Proportion, and Quantity ● Standard units are used to measure and describe physical quantities such as weight and volume.

STANDARDS ADDRESSED IN QUESTION 2: (Lesson 8)

5-ESS2-2. (5.ESS2.C.1) Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
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STANDARDS ADDRESSED IN QUESTION 3: (Lessons 8, 9)

5-ESS3-1. (5.ESS3.C.1) Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
5-ESS2-2. (5.ESS2.C.1) Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Constructing Explanations ● Construct an explanation of observed relationships.	ESS2.C: The Roles of Water in Earth's Surface Processes ● Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Systems and System Models ● A system can be described in terms of its components and their interactions.

	ESS3.C: Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	

STANDARDS ADDRESSED IN QUESTION 4: (Lessons 8, 9)		
5-ESS3-1. (5.ESS3.C.1) Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. 5-ESS2-2. (5.ESS2.C.1) Describe and graph the amounts of saltwater and freshwater in various reservoirs to provide evidence about the distribution of water on Earth.		
SCIENCE & ENGINEERING PRACTICES	**DISCIPLINARY CORE IDEAS**	**CROSSCUTTING CONCEPTS**
Constructing Explanations ● Construct an explanation of observed relationships.	ESS2.C: The Roles of Water in Earth's Surface Processes ● Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. ESS3.C: Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.	Systems and System Models ● A system can be described in terms of its components and their interactions.

Extended Task Scoring Guide (Post Assessment Only) 9 pts.

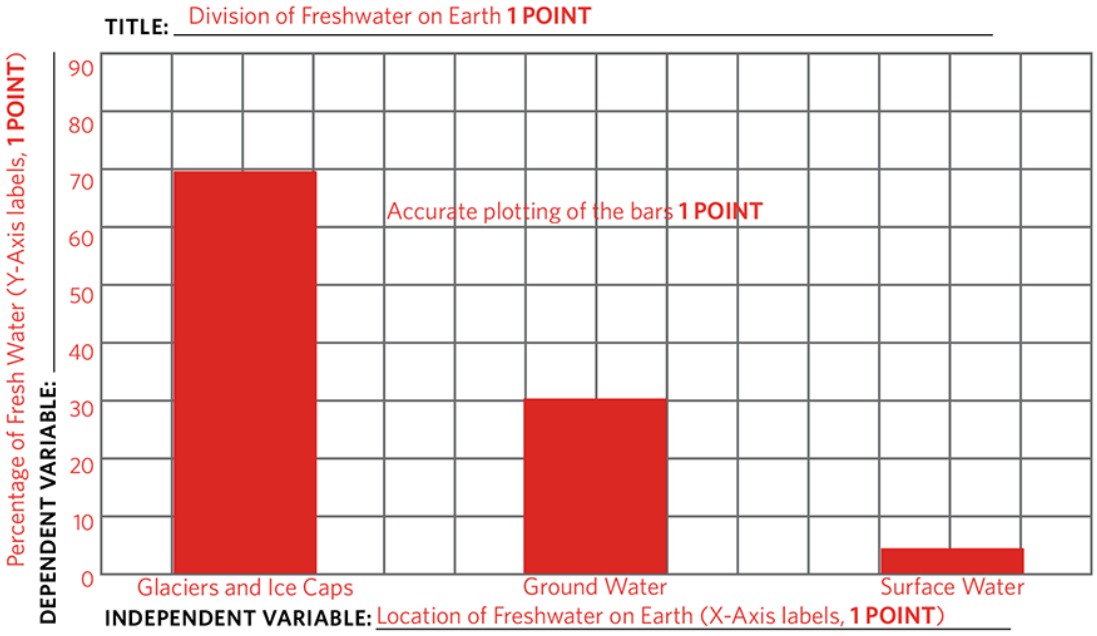
Name: **SCORING GUIDE: 9 POINTS Total** Date: _____

You are in the fifth grade in Conservationville, Missouri. Your fifth grade class is learning about using resources wisely and these lessons have got you thinking. Conservationville has a large landfill that borders a community park. The debris from this landfill is slowly leaking into a stream that flows through the park. You decide to use science ideas from class to explain how the community of Conservationville, Missouri, can protect the Earth's resources and environment and solve a potential problem.

1. How does the landfill debris in Conservationville affect the hydrosphere? 1 POINT

   Give 1 point for students explaining how the landfill can affect the hydrosphere.
   Example: Water can runoff the landfill and bring pollutants into groundwater, lakes and streams.

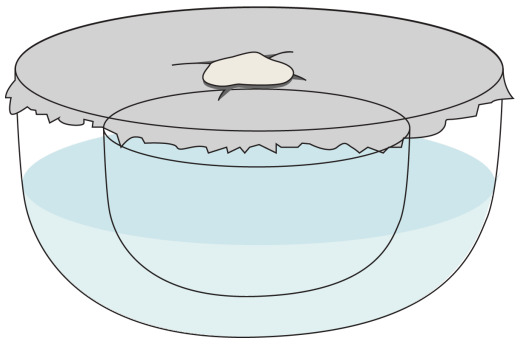
2. Freshwater makes up only 3% of the water on Earth (refer to question 3). Complete a bar graph to show the percentages of the types of freshwater on Earth. Be sure to label the axes, graph the data accurately and give the graph a title.
   Division of freshwater on Earth:
   Glaciers and ice caps: 69%
   Groundwater: 30%
   Surface water such as lakes, rivers, streams and swamps: 1% **4 POINTS**



3. Explain how to use the above graph to convince the mayor that controlling the landfill and protecting the stream is important. 1 POINT

Give 1 point for students explaining that there is limited freshwater on Earth and of the freshwater, most of it is trapped in glaciers. Therefore it is extremely important to conserve freshwater resources such as the stream which represents an extremely limited resource.

You know that most of Earth's water is in the ocean and that desalination is one way to make ocean water drinkable. You think that this model can be used to clean water in the stream contaminated by the landfill. You propose the model below to the mayor as a way to get more drinkable water for the citizens of Conservationville, MO.



4. You realize that your desalination design was not collecting enough clean water. You decide to redesign your device. You change the cover from plastic wrap to aluminum foil and change the plastic bowl to a metal pot. Would this be a fair test? 1 POINT

Give 1 point for saying no.

5. Explain your reasoning. 1 POINT

Give 1 point for explaining that in order for this to be a fair test you can only change one variable and in this case two variables were being changed so there is no way to tell which one caused the effect seen.

6. What is one way you could improve the design of this investigation? 1 POINT

Give 1 point for a suggestion for a reasonable improvement of extension of a fair test. Examples: change only the cover but keep the bowl the same, change only the bowl but keep the cover the same.

STANDARDS ADDRESSED IN QUESTION 1: (Lesson 6)

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Obtaining, Evaluating and Communicating Information ● Obtain and combine information from reliable text to explain phenomena or solutions to a design problem.	ESS3.C: Human Impacts on Earth Systems ● Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space	Systems and System Models ● A system can be described in terms of its components and their interactions.

STANDARDS ADDRESSED IN QUESTION 2: (Lesson 8)

5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Use Mathematics and Computational Thinking ● Describe and graph quantities such as area and volume to address scientific questions.	ESS2.C: The Roles of Water in Earth's Surface Processes ● Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Scale, Proportion, and Quantity ● Standard units are used to measure and describe physical quantities such as weight and volume.

STANDARDS ADDRESSED IN QUESTION 3: (Lessons 6 & 8)

5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

SCIENCE & ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Use Mathematics and Computational Thinking ● Describe and graph quantities such as area and volume to address scientific questions	ESS2.C: The Roles of Water in Earth's Surface Processes ● Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere.	Scale, Proportion, and Quantity ● Standard units are used to measure and describe physical quantities such as weight and volume

STANDARDS ADDRESSED IN QUESTION 4: (Lesson 3)

3-5-ETS1- 3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
STANDARDS ADDRESSED IN QUESTION 5: (Lesson 3)
3-5-ETS1- 3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
STANDARDS ADDRESSED IN QUESTION 6: (Lesson 3)
3-5-ETS1- 3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.